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ORIGINAL ARTICLE

# Diagnostic value of magnetic resonance cholangiopancreatography in cholestatic jaundice

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## KEYWORDS

Cholestatic jaundice;  
US;  
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**Abstract** *The aim of the study:* To evaluate the diagnostic accuracy of magnetic resonance cholangiopancreatography in patients with cholestatic jaundice.

*Patients and methods:* Clinical, laboratory and investigational data were evaluated from 50 patients with cholestatic jaundice. MRCP findings were compared with ERCP or operative findings and appropriate clinical endpoints.

*Results:* The ERCP or operative findings and appropriate clinical endpoints revealed 23 patients with intra or extra hepatic biliary dilatation and 27 patients without intra or extra hepatic biliary dilatation. As regards the 23 patients with biliary dilatation, biliary dilatation was evident in 19 patients by U/S versus 23 patients by MRCP. ERCP was successful in 20 patients (87%) and was not done in three patients (13%). In cases of obstructive jaundice the sensitivity of MRCP was 100% versus 86% in choledocholithiasis and malignant detection, respectively  $p$  value  $<0.05$ .

*Conclusion:* MRCP is highly sensitive and specific for biliary dilatation and avoids the need for invasive imaging in most patients with cholestasis. MRCP permits reservation of ERCP to patients with a high probability of therapeutic intervention.

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## 1. Introduction

Cholestasis is any condition in which the flow of bile from the liver is slowed or blocked. Cholestasis broadly fall into two categories: those where there is a mechanical blockage in the duct system – obstructive or extrahepatic cholestasis. And those where there are disturbances in bile formation – hepatocellular or intrahepatic cholestasis (1).

Extrahepatic causes are further sub-divided into intra-ductal and extra-ductal. Neoplasm, choledocholithiasis, biliary

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stricture, parasites and primary sclerosing cholangitis lead to intra-ductal obstruction. External compression of biliary channels by neoplasm, pancreatitis or cystic duct stones with subsequent gallbladder distention lead to extra-ductal obstruction. Obstructive jaundice is a clinical terminology used for a condition associated with significant morbidity and mortality. Early and accurate diagnosis is very important in obstructive jaundice so that its outcomes should be controlled as early as possible (2).

Although abdominal ultrasonography (U/S) is non-invasive, quick and inexpensive, yet it is very operator and patient dependent (3).

Endoscopic retrograde cholangiopancreatography (ERCP) is currently the 'gold standard' for the diagnosis of biliary obstruction. It is one of the several invasive direct cholangiography techniques. However, it is an imperfect diagnostic tool and other procedures may be more appropriate gold standards for diagnosis in the future (4).

Magnetic resonance cholangiopancreatography (MRCP) is an alternative to diagnostic ERCP for imaging the biliary tree and investigating biliary obstruction. MRCP was developed in 1991 and techniques are continuing to improve (5). Although ERCP is still the standard of reference for imaging the pancreaticobiliary system, there are specific advantages of MRCP over ERCP. MRCP (a) is noninvasive; (b) is cheaper; (c) uses no radiation; (d) requires no anesthesia; (e) is less operator dependent; (f) allows better visualization of ducts proximal to an obstruction; and (g) when combined with conventional T1- and T2-weighted sequences, allows detection of extraductal disease. The only disadvantage of MRCP is that intervention is not possible, yet it is possible and can be therapeutic with ERCP (6).

*The aim of this study* is evaluating the diagnostic accuracy of magnetic resonance cholangiopancreatography in patients with cholestatic jaundice.

## 2. Patients and methods

### 2.1. Patients

Fifty patients with cholestatic jaundice were enrolled in our study, they were identified from the Ain Shams University Specialized Hospital during the period from August 2011 to June 2012. All patients were subjected to the following: medical history and clinical examination, laboratory investigations (liver profile, pancreatic enzymes, viral markers, autoimmune markers, tumor markers), abdominal ultrasound was the initial screening investigation done for all patients, followed by MRCP. In biliary dilation ERCP was the reference imaging technique. When ERCP failed, PTC and operative CBD exploration were the reference while the clinical endpoints in cases without biliary dilatation were the reference standards.

### 2.2. Ultrasound

Gray-scale US of the entire abdomen was performed in all patients by an expert radiologist using a 3.75-MHz convex-array transducer (GE, LOGIC 900, PRO series). Routine gallbladder examination should be conducted on an adequately distended gallbladder whenever possible. In most cases, fasting prior to elective examination will permit adequate distension

of a normally functioning gallbladder. The gallbladder evaluation included long-axis and transverse views obtained in the supine position. Other positions such as left lateral decubitus, erect, or prone may be helpful to evaluate the gallbladder and its surrounding areas completely. Measurements were taken to determine gallbladder wall thickening. If the patient presented with pain, tenderness to transducer compression was assessed. The intrahepatic ducts were evaluated by obtaining views of the liver demonstrating the right and left branches of the portal vein.

Doppler was used to differentiate hepatic arteries and portal veins from bile ducts. The intrahepatic and extrahepatic bile ducts were evaluated for dilatation, wall thickening, and intraluminal findings like stones or masses. The bile duct in the porta hepatis was measured and documented for any pathology. When visualized, the distal common bile duct in the pancreatic head should be evaluated. The pancreatic head was evaluated for any pathology. Also the entire pancreas should be scanned for dilated ducts +/- stones, calcifications, and focal or diffuse pathology.

### 2.3. ERCP

Patients routinely undergo intravenous sedation. Patients lie in the left lateral decubitus position for introduction of the endoscope into the duodenum and are then turned into the prone oblique position. If cannulation of the biliary tree is difficult, a flexible guide wire or sphincterotome is used. The inferior submucosal papillary sphincter is cut by sphincterotomy.

### 2.4. MRCP

Patients are fasted for 4 h prior to the study in order to reduce fluid secretions within the stomach and duodenum, reduce bowel peristalsis and promote gallbladder distension. MRCP was performed on a 1.5T superconducting magnet system (General Electric Corp, Milwaukee, WI, USA), using a phased array body coil. Each patient underwent imaging with 2D SSFSE (single shot fast spin echo) MRCP sequences, which included coronal thin section (thin slab) imaging and rotating oblique coronal thick-slab MR imaging.

Imaging parameters are summarized in Table 1. Breath holds for thin-section 2D SSFSE imaging were at end inspiration after two preceding full respiratory cycles. Thick-slab MR images were obtained at end inspiration of sequential breath holds, after expiration and repeat full inspiration. The 2D SSFSE thin-section images were obtained with a section thickness of 3 mm and no gap. The number of coronal images obtained varied from 15 to

**Table 1** Summary of MRCP imaging parameter.

Parameter	Thin slab	Thick slab
Echo time (ms)	800	900
Repetition time (ms)	NA	NA
Bandwidth	31.25	31.25
Acquisition plane	Coronal	Rotating oblique coronal
Field of view (cm)	42 × 37.8	26 × 26
Section thickness (mm)	3 mm (no intersection gap)	40 mm

68 (median, 21) divided into one to four contiguous acquisitions, with breath-hold duration of 20–30 s per acquisition.

The 2D SSFSE thick-slab images were obtained as four to six rotating oblique coronal images with 40-mm-thick sections, breath-hold duration of 3 s per image.

Technologists prescribed oblique thick-slab images from a previously performed axial T2-weighted FRFSE sequence with fat saturation (repetition time ms/echo time ms, 4500/90) and had sample annotated images to aid in slab placement. The technologists were instructed at minimum to obtain slabs oriented parallel to the pancreatic head, in a straight coronal plane, parallel to the pancreatic tail, and centered obliquely on the middle portion of the common bile duct to cover the biliary tree.

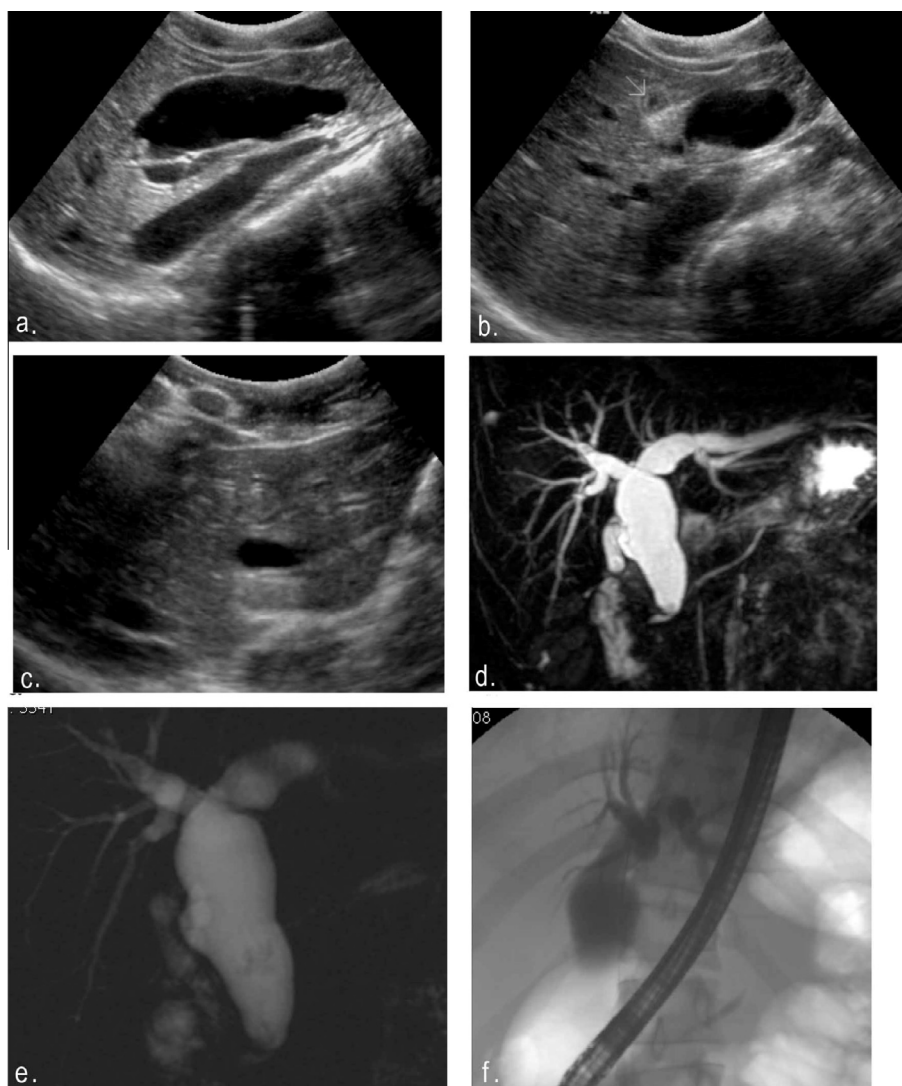
Then MIP reformats were generated. MIP reformats can be generated in various coronal and sagittal oblique planes. These sequences as well as MIP reformat are useful in displaying pancreaticobiliary tree thus can identify congenital anomalies

as choledochal cyst and pancreatic divisum (Figs. 1 and 2). Also detecting biliary obstruction, define its level and identify a potential cause as stones (Fig. 4), benign and malignant strictures (Figs. 3 and 7).

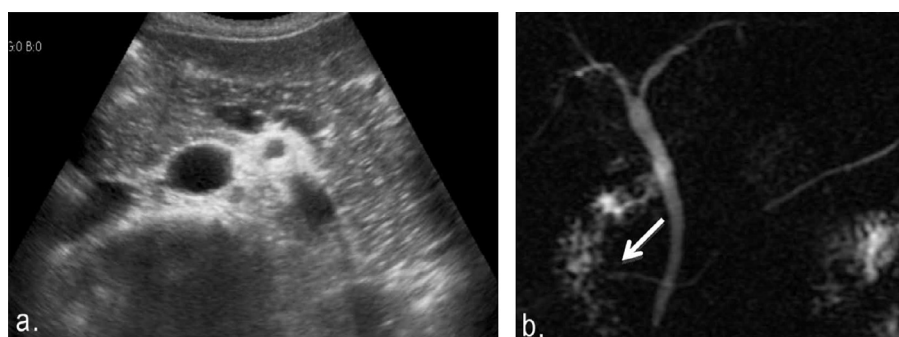
In order to evaluate the duct walls, and any focal parenchymal pathology, 3D fat suppressed T1-weighted GRE sequences can also be performed. The combination of T1- and T2-weighted sequences, allows detection of extra ductal disease, thus adds to the diagnostic value of MRCP, e.g. acute pancreatitis (Fig. 5), pancreatic masses (Fig. 6), porta hepatis masses or lymph nodes (Fig. 8), thus further investigation can be recommended as appropriate (see Figs. 9 and 10).

## 2.5. Statistical analysis

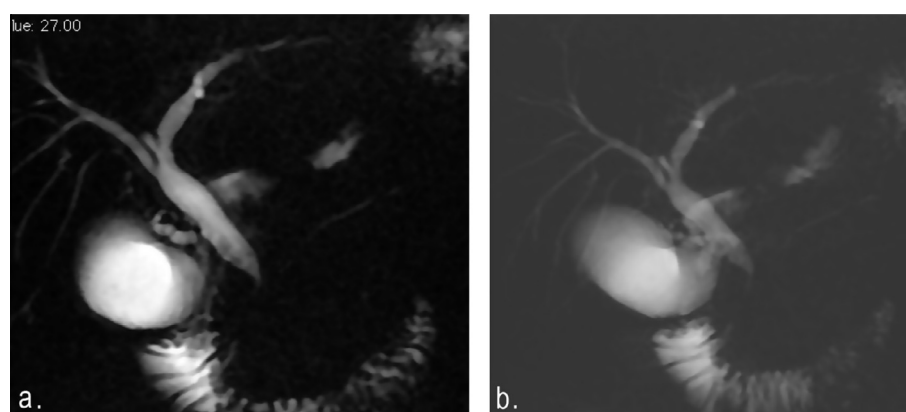
Images were independently and blindly reviewed by two expert radiologists with documentation of the interobserver agreement and variability.



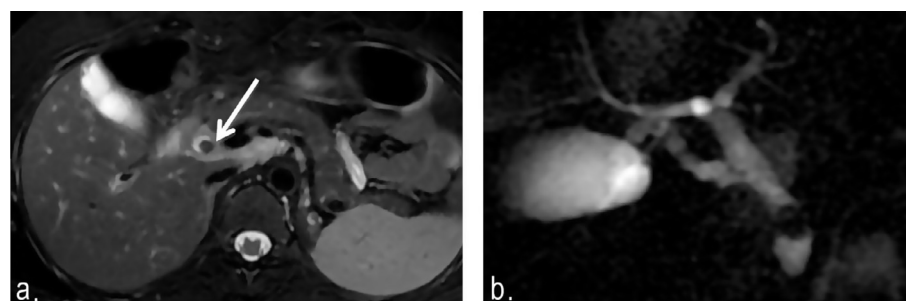
**Fig. 1** Type I choledochal cyst: A 22 years old male patient who presented with right upper quadrant pain. (a–c) Abdominal ultrasound revealed appreciable fusiform dilatation of the CBD harboring biliary sludge, which was first interpreted as distended gall bladder yet on the repeat scan the gall bladder was seen contracted (arrow in b), associated intrahepatic biliary radicle dilatation is seen (c). (d and e) coronal MIP as well as thick slab MRCP revealed marked fusiform dilatation of the CBD with dilated intrahepatic biliary radicles, and multiple filling defects within biliary sludge. (f) Preoperative ERCP was done for the patient.



**Fig. 2** Pancreatic divisum: A 45 years old male patient who presented with epigastric pain, and history of recurrent pancreatitis. (a) Abdominal ultrasound revealed prominent pancreatic shadow with no intra or extra hepatic biliary radicle dilatation. (b) Coronal MIP reformats show the main pancreatic duct draining into the minor duodenal papilla (arrow), proximal to the insertion of the CBD, which drains more inferiorly into the major duodenal papilla.



**Fig. 3** A 24 years old male patient who presented with jaundice. (a and b) Thin and thick slab MRCP showing stricture in the lower third of the CBD with smooth margins, symmetric narrowing and gradual tapering with dilated proximal part of the CBD and intrahepatic biliary radicle dilatation, thus benign CBD stricture was diagnosed. ERCP (not shown) and tissue biopsy confirmed benign nature of the stricture.



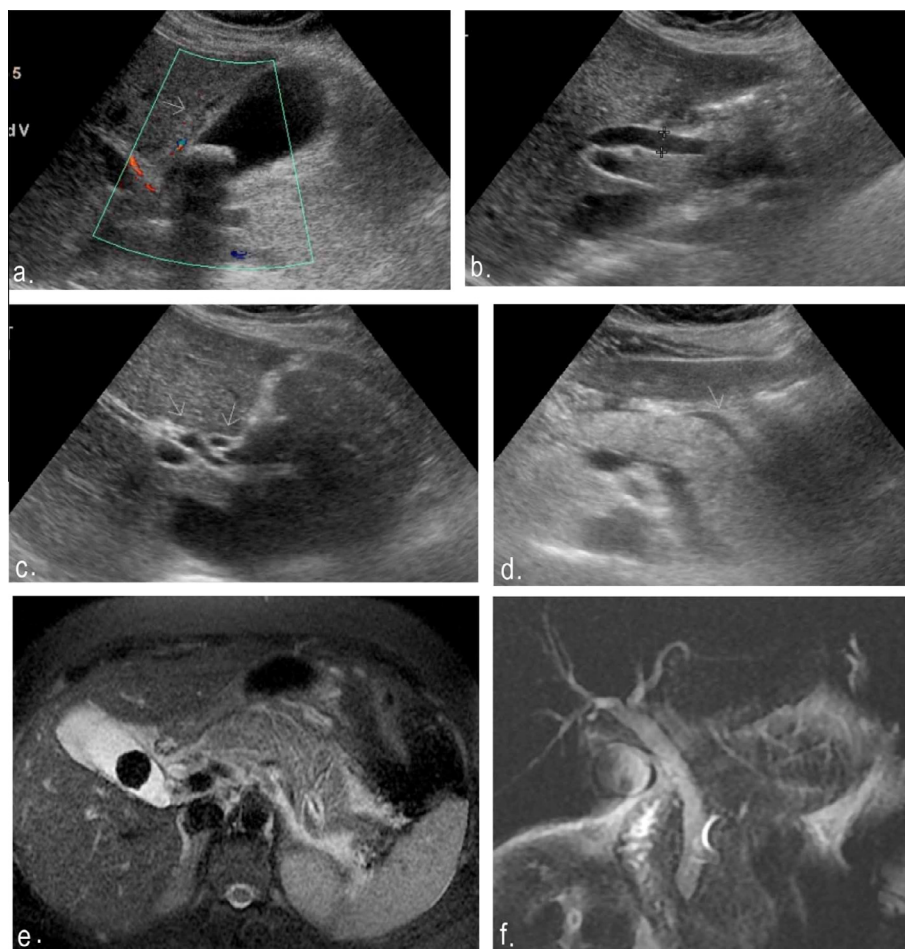
**Fig. 4** A 30 years old female patient who presented with jaundice. (a) Axial T2-weighted fat saturated image and (b) Thick slab MRCP revealed a CBD stone seen as a low signal-filling defect in the distal CBD (arrow in a) with mild upstream and intrahepatic biliary radicle dilatation. No gall bladder stones detected.

SPSS statistical software package (Version 17) was used for data analysis. Data were expressed as mean  $\pm$  SD for quantitative measures. Using Student's *t* test sensitivity, specificity, positive and negative predictive values were calculated.  $P > 0.05$  was considered statistically non significant,  $P < 0.05$  was considered statistically significant and  $P < 0.01$  was considered statistically highly significant.

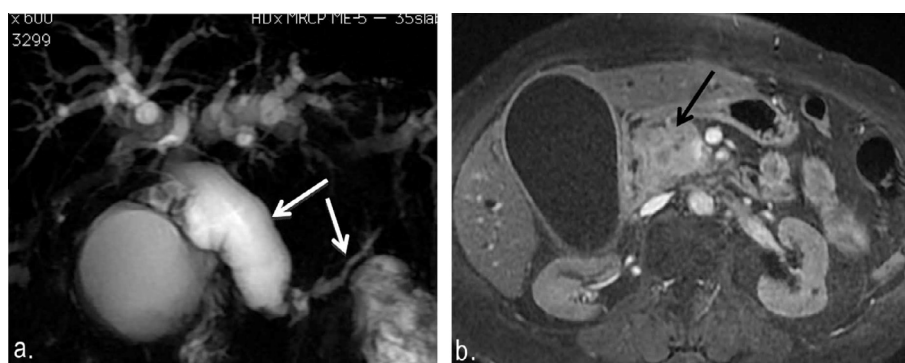
### 3. Results

Fifty patients were with cholestatic jaundice of whom 26 (52%) were females with mean age of 35 years (range 16–64 years). Abdominal pain was the predominant symptom at presentation ( $n = 32$ ), followed by jaundice ( $n = 18$ ).





**Fig. 5** A 33 years old female patient who presented with abdominal pain. (a–d) Abdominal ultrasound revealed distended calculous gall bladder with thickened edematous wall and pericholecystic collection (arrow in a), dilated CBD about 8 mm in diameter, however its distal end could not be properly assessed. The hepatic ducts were seen dilated (arrows in c). The pancreas was swollen, with mild amount of peripancreatic fluid (arrow in d). (e) Axial T2-weighted fat sat image revealed diffusely swollen pancreas with peripancreatic fluid consistent with acute pancreatitis. (d) Coronal thick slab MRCP revealed dilated CBD with attenuated caliber of its distal portion, yet no definite CBD stones detected, and no intra hepatic biliary radicle dilatation. It was diagnosed as gall stone pancreatitis that most likely passed, with swollen pancreas compressing the distal CBD. Follow up study was done (not shown) revealed resolved pancreatitis with resolved attenuation of distal CBD.



**Fig. 6** Pancreatic head carcinoma: a 45 years old male patient who presented with jaundice. (a) Coronal thick slab MRCP showed the 'double duct' sign with dilatation of both the CBD and pancreatic duct (arrows) and distension of the gallbladder. Contrast enhanced MRI was recommended for the patient. (b) Axial T1 post contrast fat saturation image revealed an inhomogeneously enhancing irregular pancreatic head mass (arrow).



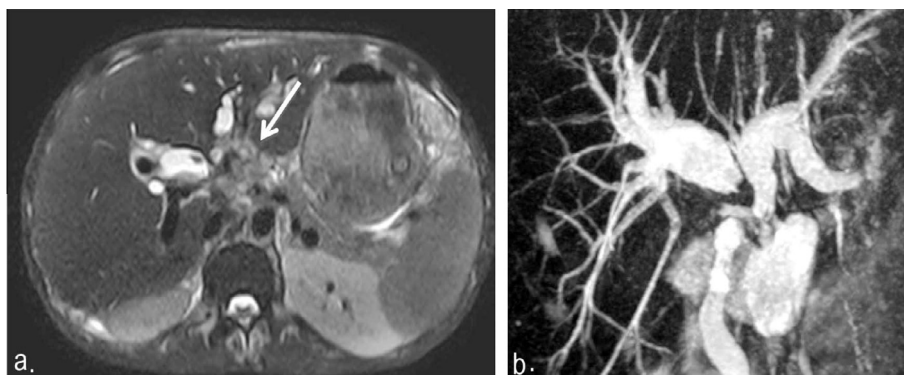
**Fig. 7** Coronal MIP reformat shows intrahepatic bile duct dilatation and a grossly dilated CBD with abrupt distal termination, dilatation of the main pancreatic duct is seen as well with ectasia of its side branches. ERCP was done for the patient and biopsy was obtained from a periampullary tumor.

The results of our study revealed 23 patients with intra or extra hepatic biliary dilatation, in 27 patients there was no intra or extra hepatic biliary dilatation. The results are summarized in [Table 2](#).

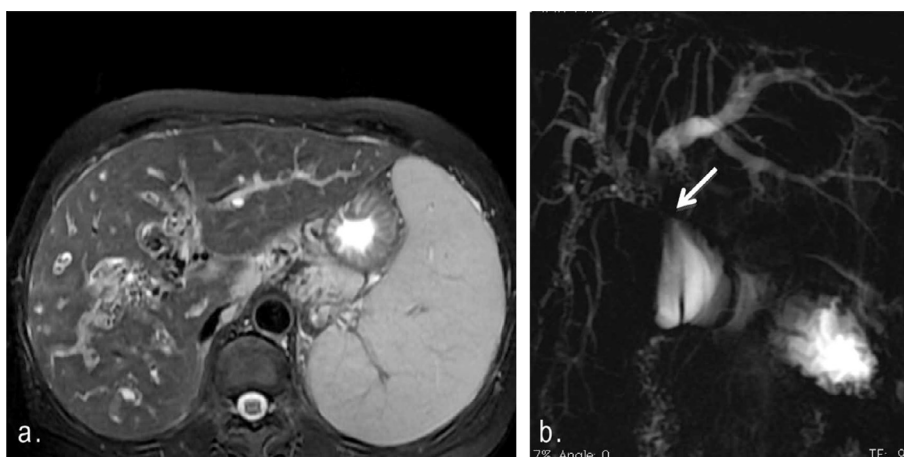
Biliary dilatation was evident in 19 patients by U/S versus 23 by MRCP [Table 3](#).

ERCP was attempted in 23 patients (46%); ERCP was successful in 20 patients (87%). In our study, 10 patients underwent sphincterotomy and stone extraction. In 9 patients stent was applied, in four of which tissue biopsy was obtained. In our study there was one case of choledochal cyst for which ERCP was done as preoperative assessment for any anomalous pancreaticobiliary junction.

ERCP was not done in three patients; two patients had gall stone pancreatitis with periampullary edema, it failed in one patient and in the other patient no CBD stones were detected by MRCP so conservative management was decided and follow up MRCP revealed resolved biliary dilatation which con-



**Fig. 8** A 29 years old male patient who presented with obstructive jaundice. (a) Axial T2 weighted fat sat image revealed lymph nodal mass at the porta hepatis (arrow) with moderate intrahepatic biliary radicle dilatation. A hepatic focal lesion was also seen at hepatic sub segment IV (not shown). (b) Coronal MIP revealed moderate diffuse dilatation of intrahepatic biliary radicles and both hepatic ducts with abrupt termination at their confluence. Patient was diagnosed as metastases of unknown origin for further metastatic work up.



**Fig. 9** A 46 years old female patient who had a past history of choledochojejunostomy and presented with jaundice. (a) T2 weighted fat saturated image revealed significantly dilated intrahepatic biliary radicles being the seat of numerous stones seen as low signal filling defects. Complementary CT done for the patient (not shown) revealed associated pneumobilia. (b) Thick slab MRCP revealed focal stenosis at the choledochojejunostomy anastomotic site (arrow).



**Fig. 10** Missed CBD stone: a 56 years old male patient who presented with jaundice post laparoscopic cholecystectomy (4 weeks earlier). (a) Axial T2-weighted fat sat image revealed a filling defect at the proximal part of the common bile duct (arrow). An inhomogenously hyperintense post operative collection was also seen. (b and c) 3-D and thick slab MRCP revealed the presence of stone at the proximal CBD seen at a short distance distal to the common hepatic duct with dilated proximal CBD as well as intrahepatic biliary radicles. Distal CBD is of normal caliber.

**Table 2** Different diagnoses in our study.

Patients with biliary dilatation ( <i>n</i> = 23)		Patients with no biliary dilatation ( <i>n</i> = 27)	
Diagnosis	No. of patients	Diagnosis	No. of patients
Choledochal cyst	1 (Fig. 1)	Pancreatic divisum	2 (Fig. 2)
Benign CBD stricture	2 (Fig. 3)	Hepatic cholestasis	10
Stones	10 (Fig. 4)	Gall stone pancreatitis	5
Gall stone pancreatitis <i>n</i> = 3	(Fig. 5)		
Malignant obstruction	7	Cholangitis	4
Cancer pancreas <i>n</i> = 3	(Fig. 6)	Hepatocellular carcinoma	6
Cholangiocarcinoma <i>n</i> = 2	(Fig. 7)		
Hepatocellular carcinoma <i>n</i> = 1			
Metastatic porta hepatis lymph node <i>n</i> = 1	(Fig. 8)		
Post-operative	3		
Biliary ligation <i>n</i> = 1			
Anastomotic stricture <i>n</i> = 1	(Fig. 9)		
Missed CBD stone <i>n</i> = 1	(Fig. 10)		

**Table 3** Diagnostic value of MRCP vs. U/S in detection of biliary dilatation in cholestatic jaundice.

	U/S (%)	MRCP (%)	<i>P</i> value
Sensitivity	65.5	95.7	<0.05
Specificity	85.2	96.3	<0.05
PPV	87.9	95.7	<0.05
NPV	74.2	96.3	<0.05
Efficacy	78	96	<0.05

firmed the absence of CBD stones. The third patient had post-operative choledocojejunostomy.

When ERCP failed, comparative imaging data were available from other invasive procedures, intra operative cholangiography, or percutaneous cholangiography.

The combination of T1 and T2 sequences guided the diagnosis of 19 cases namely cases of gall stone pancreatitis, pancreatic carcinoma, metastatic porta hepatis lymph nodes,

hepatocellular carcinoma, and further dedicated investigations were done when indicated.

In cases of obstructive jaundice detected in our study (23 patients) ultrasound could not depict the level and/or the cause of obstruction in 6 patients. The sensitivity of U/S was about 77% in both malignant and choledocholithiasis detection while the sensitivity of MRCP 100% in choledocholithiasis versus 86% in malignant detection ( $P < 0.05$ ).

#### 4. Discussion

When evaluating a case of cholestatic jaundice the aim of the radiologist is to confirm the presence of obstruction and to identify its location, extent and possible cause. Ultrasound has traditionally been used as the initial screening procedure because of its many advantages, which include its availability, its cost effectiveness, and no requirement of contrast material and lack of ionizing radiation. However, although it is well suited to visualize the common hepatic duct and proximal CBD, one of its major limitations is assessment of the distal CBD and pancreas, which are often obscured by bowel gas in about 30–50% of patients. Obesity is also an important limiting factor. Other cases missed by ultrasound were stricture and cases of small mass lesions involving the head of pancreas (7).

In our study ultrasound could not depict the level and/or the cause of obstruction in six patients. The sensitivity of U/S was about 77% in both malignant and choledocholithiasis detection while the sensitivity of MRCP 100% in choledocholithiasis versus 86% in malignant detection ( $P < 0.05$ ). These results were similar to those obtained by Upadhaya et al., 2006 who found that ultrasound could identify the cause of obstruction in 77% of cases.

ERCP, since first appearance in 1970, in the evaluation of biliary tree, also owing to its therapeutic feature, continues to be the gold standard imaging method. But, today, in addition to high diagnostic accuracy of MRCP, as an invasive method the morbidity and mortality rate of ERCP reaches about 7% and 1%, and this limits the use of ERCP for diagnosis. Also, in the case of hepaticojejunostomy and choledochojejunostomy, ERCP cannot be performed; in the case of gastric resection, retroperitoneal neoplasm, duodenal diverticulum, and ampullary edema, performing ERCP is hard. ERCP, dependent on the practitioner, in some of the cases failed (3–18%) or was inadequate (8). As in our study ERCP was not done in three patients (13%); one due to history of choledochojejunostomy, the other two cases had gall stone pancreatitis, in one of them it failed due to periampullary edema and in the other conservative management and follow up were decided as no CBD stones detected on MRCP.

In our study 27 patients had no intra or extra hepatic biliary dilatation (5 gall stones pancreatitis, 4 cholangitis, 2 pancreatic divisum, 10 hepatic cholestasis and 6 hepatocellular carcinoma).

The use of MRCP for the initial “screening” of patients at risk of choledocholithiasis permits selection for more invasive procedures based on a high probability of therapeutic intervention. It offers a safer and more acceptable alternative to diagnostic ERCP (9). MRCP carries an additional advantage of diagnosing abnormalities of the biliary tree including duplication, choledochal cyst, pancreatic divisum and cholangiocarcinoma. The superior sensitivity of MRCP over ERCP in

diagnosing primary sclerosing cholangitis (10,11), and intrahepatic calculi has been well documented (12). A disadvantage of MRCP is that currently no therapeutic options are available for the management of common duct calculi.

In our study MRCP had a negative predictive value (NPV) of 96.3% to exclude biliary dilatation with a sensitivity of 95.7% and a positive predictive value (PPV) to confirm biliary dilatation of 95.7% with a specificity of 96.3%. The diagnostic accuracy of MRCP in the diagnosis of biliary dilatation was 96%.

Sugiyama et al. reported a sensitivity of 100% from their series of 101 patients (13), but Mendler et al. found MRCP less sensitive for smaller stones (less than 3 mm) (14).

Our study reported that patients undergoing MRCP for suspected biliary dilatation had a sensitivity for the diagnosis 100% vs. 86% in choledocholithiasis and malignant detection, respectively.

The median sensitivity for choledocholithiasis (13 studies) was 93% and the median specificity 94%. Reported sensitivities for malignancy were somewhat lower, ranging from 81% to 86%, and specificities ranged from 92% to 100%. There was some evidence that MRCP is an accurate diagnostic test in comparison to ERCP. The probability of avoiding unnecessary diagnostic ERCP is estimated at 30%. These patients could avoid the unnecessary risk of complications and death associated with diagnostic ERCP, and substantial cost saving would be gained. There is some evidence that MRCP is an accurate investigation compared with diagnostic ERCP, although the values for malignancy compared with choledocholithiasis were somewhat lower (15).

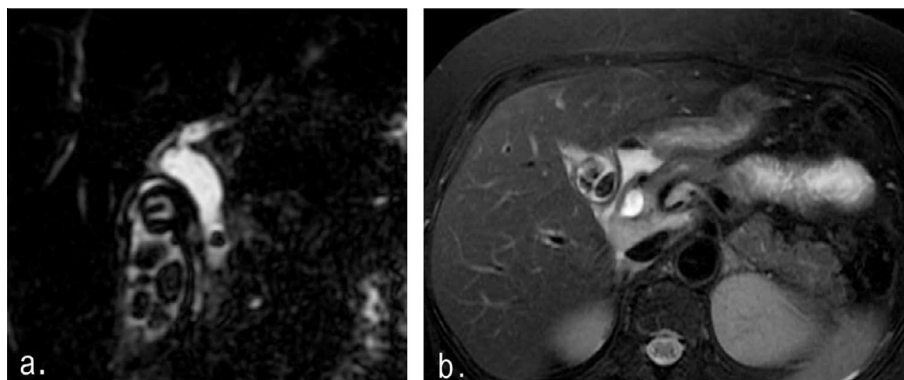
Shanmugam et al. (16) found that in 51 patients, ERCP was performed unsuccessfully, whereas MRCP in the same group of patients did not show evidence of ductal calculi. This cohort of patients were managed conservatively and recovered without sequelae. This implies that invasive ERCP could have been potentially avoided in some patients. Avoiding these examinations would have effectively resulted in considerable resource release.

In our study there was one false positive MRCP (stone and intra hepatic biliary dilatation) (Fig. 11). The exact cause of that false positive result was unknown, but we suspected that it was possibly a passed stone (at the time interval between performing MRCP and ERCP), an artifact, or could be attributed to the explanation given by Griffin et al. (17) as they stated that pulsatile vascular compression from adjacent vessels might mimic a stricture. The commonest site of extrinsic vascular compression is the common hepatic duct, followed by the left hepatic duct, both due to the right hepatic artery crossing its posterior aspect. The mid portion of the CBD may also be narrowed due to the gastro-duodenal artery. Pseudo-obstruction is typically seen as a band like compression with minimal proximal dilatation, and it should not be misdiagnosed as a bile duct tumor or biliary stone.

The performance of MRCP in enabling differentiation of benign strictures (smooth margins, symmetric narrowing and gradual tapering) from strictures caused by extrahepatic cholangiocarcinoma (irregular margins, asymmetric or abrupt narrowing) is comparable with that of ERCP (18).

ERCP may have some limitations as regards identification of distal bile duct stenosis in cases of critical stenosis. The non-invasive nature and panoramic capabilities of MRCP and the fact that no contrast material is needed make MRCP the examination of reference in the diagnosis of malignant





**Fig. 11** A 50 years old female patient who presented with right hypochondrial pain. (a) Coronal MIP revealed multiple gall bladder calculi filling defects, with relatively higher position of the gall bladder indenting the main hepatic duct. There was a slight dilatation of the caliber of the CBD with a small filling defect seen at its proximal portion that was interpreted as CBD stone. (b) Axial T2 fat sat image revealed minimal pericholecystic edema denoting an acute attack on top of chronic cholecystitis. ERCP was done for the patient (not shown) revealed normal CBD without any calculi denoting false positive result obtained by MRCP, and the filling defect seen could be an artifact, vascular compression or passed stone.



**Fig. 12** A 40 years old male patient who presented with jaundice. a and b Thick slab MRCP: (a) a few small gall bladder calculi are seen (arrow). (b) Mild dilatation of the CBD as well as intrahepatic biliary radicles with no evidence of calculi or strictures so it was thought to be a passed stone, however, this was a false negative case as it was proved latter by ERCP and tissue biopsy to be malignant stricture at the distal CBD.

stenosis of the distal bile duct, also thanks to its ability to visualize the entire biliary tree in the presence of critical strictures of the common bile duct. The rationale for the use of ERCP lies in the possibility of taking histological samples and performing minimally invasive surgical interventions (19). In our study there was one case of false negative MRCP (missed malignant stricture) (Fig. 12), probably because the stricture was at the distal most part of the CBD, the cause of biliary dilatation at MRCP was attributed to a passed stone as the patient had calculi gall bladder, yet ERCP and tissue biopsy revealed distal CBD cholangiocarcinoma.

Evaluation of the biliary-enteric anastomosis is difficult by ERCP due to altered bowel anatomy. Long-term complications of biliary enteric anastomosis include recurrent obstruction secondary to anastomotic stenosis/stricture, cholangitis,

intrahepatic stones and dilated bile ducts. MRCP can show the site of anastomosis, status of the intrahepatic ducts, stones and strictures (20).

In our study one case of stricture at the site of choledocojejunostomy was successfully diagnosed by MRCP as proven by surgical data (in which ERCP had failed and could not be done).

We believe that the small false positive rate for MRCP is comfortably outweighed by the incidence of the hazards of “unnecessary” ERCP where this is confined to patients in whom the probability of operative intervention is high. Clearly, further longitudinal follow-up data must be awaited for patients with negative MRCP results with transient jaundice or pancreatitis in whom a decision is made not to undertake ERCP.

Magnetic resonance cholangiopancreatography (MRCP) is an alternative to diagnostic endoscopic retrograde cholangiopancreatography (ERCP) for investigating biliary obstruction. The use of MRCP, a non-invasive procedure, may prevent the use of unnecessary invasive procedures.

## 5. Conclusion

MRCP is highly sensitive and specific for biliary dilatation and avoids the need for invasive imaging in most patients with suspected obstructive jaundice. MRCP is becoming the initial imaging tool for the biliary system, with ERCP reserved for therapeutic indications.

## References

- (1) Afdhal NH. Diseases of the gallbladder and bile ducts. In: Goldman L, Ausiello D, editors. *Goldman's Cecil Medicine*. Philadelphia, PA: Saunders Elsevier; 2011 [chapter 158].
- (2) Mubarak A, Ishtiaq A, Amjad S, Mirza WA. Diagnostic accuracy of magnetic resonance cholangio-pancreatography in evaluation of obstructive jaundice. *JPMA* 2012;62:1053.
- (3) Vogl TJ, Zeuzem S, Zangos S, Hammerstingl R. Magnetic resonance cholangiopancreatography (MRCP) from a radiological and gastroenterological perspective. *Dtsch Med Wochenschr* 2009;134(19):1011–4.
- (4) Sheridan MB. Endoscopic retrograde cholangiopancreatography should no longer be used as a diagnostic test: the case in favour. *Digest Liver Dis* 2002;34:370–4.
- (5) Halefoglu AM. Magnetic resonance cholangiopancreatography: a useful tool in the evaluation of pancreatic and biliary disorders. *World J Gastroenterol* 2007;13:2529–34.
- (6) Vitellas KM, Mary KT, Sptitzer CE, Nelson RC. MR cholangiopancreatography of bile and pancreatic duct abnormalities with emphasis on the single shot fast spin echo technique. *Radiographics* 2000;20:575–939.
- (7) Upadhyaya V, Upadhyaya DN, Ansari MA, Shukla VK. Comparative assessment of imaging modalities in biliary obstruction. *Indian J Radiol Imaging* 2006;16(4):577–82.
- (8) Schumacher B. Diagnostik und Therapie von Gallenwegserkrankungen-ERCP und MRCP. *Gastroenterologie Up2date* 2006;2(2):155–64.
- (9) Pickuth D. Radiologic diagnosis of common bile duct stones. *Abdom Imaging* 2000;25:618–20.
- (10) Vittelas KM, El-Dieb A, Vaswani KK, Bennett WF, et al. MR cholangiopancreatography in patients with primary sclerosing cholangitis: inter-observer variability and comparison with endoscopic retrograde cholangiopancreatography. *AJR Am J Roentgenol* 2002;179:399–407.
- (11) Angulo P, Pearce DH, Johnson CD, et al. Magnetic resonance cholangiography in patients with biliary disease: its role in primary sclerosing cholangitis. *J Hepatol* 2000;33:520–7.
- (12) Kim TK, Kim SB, Kim JH, et al. Diagnosis of intra-hepatic stones: superiority of MR cholangiopancreatography over endoscopic retrograde cholangiopancreatography. *AJR Am J Roentgenol* 2002;179:429–34.
- (13) Sugiyama M, Atomi Y, Hachiya J. Magnetic resonance cholangiography using half-fourier acquisition for diagnosing choledocholithiasis. *Am J Gastroenterol* 1998;93:1886–90.
- (14) Mandler MH, Bouillet P, Sautereau D, et al. Value of MR cholangiography in the diagnosis of obstructive diseases of the biliary tree: a study of 58 cases. *Am J Gastroenterol* 1998;93:2482–90.
- (15) Kaltenthaler E, Vergel YB, Chilcott J, Thomas S, Blakeborough T, Walters SJ, et al. Systematic review and economic evaluation of magnetic resonance cholangiopancreatography compared with diagnostic endoscopic retrograde cholangiopancreatography. *Health Technol Assess* 2004;8(Mar 10):1–89, iii.
- (16) Shanmugam V, Beattie GC, Yule SR, Reid W, Loudon MA. Is magnetic resonance cholangiopancreatography the new gold standard in biliary imaging? *Br J Radiol* 2005;78:888–93.
- (17) Griffin N, Charles-Edwards G, Grant LA. Magnetic resonance cholangiopancreatography: the ABC of MRCP Insights. *Imaging* 2012;3:11–21.
- (18) Gulati K, Catalano OA, Sahani DV. Advances in magnetic resonance cholangiopancreatography: from morphology to functional imaging. *Indian J Radiol* 2007;17(4):247–53.
- (19) Di Cesare E, Puglielli E, Michelini O, Pistoia MA, Lombardi L, Rossi M, et al. Malignant obstructive jaundice: comparison of MRCP and ERCP in the evaluation of distal lesions. *Radiol Med* 2003;105(5–6):445–53.
- (20) Al-Dhuhli H. Role of magnetic resonance cholangiopancreatography in the evaluation of biliary disease. *SQU Med J* 2009;9(3):341–53.